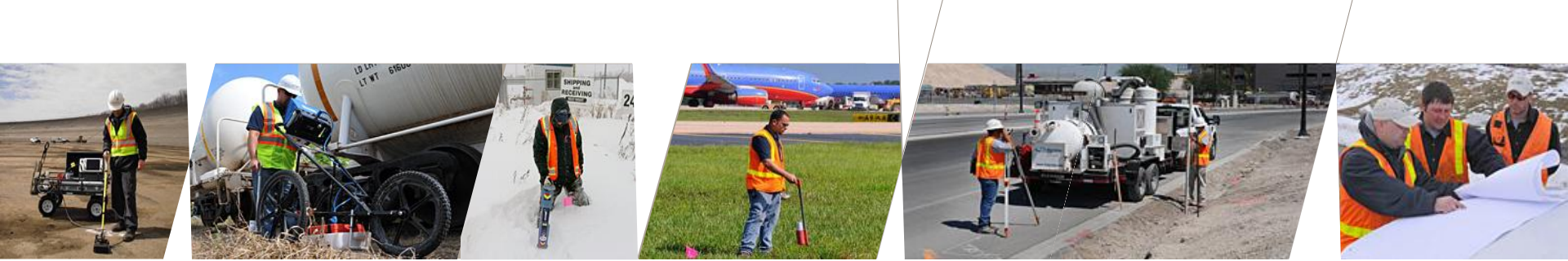


Subsurface Utility Engineering (SUE)



2013 Purdue Road School
March 5, 2013



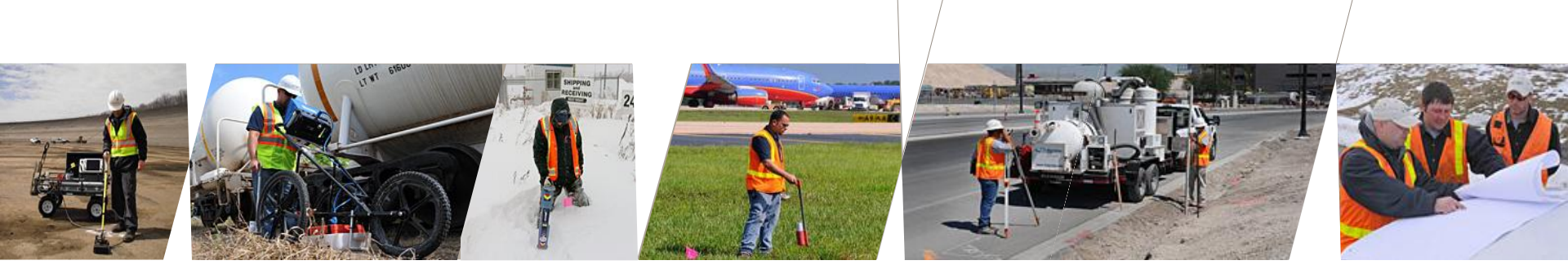
Outline

- What is Subsurface Utility Engineering (SUE)?
- Overview of SUE - Definitions
- When to Use SUE
- How to Use SUE
- Why Use SUE



What is Subsurface Utility Engineering?





What is Subsurface Utility Engineering?

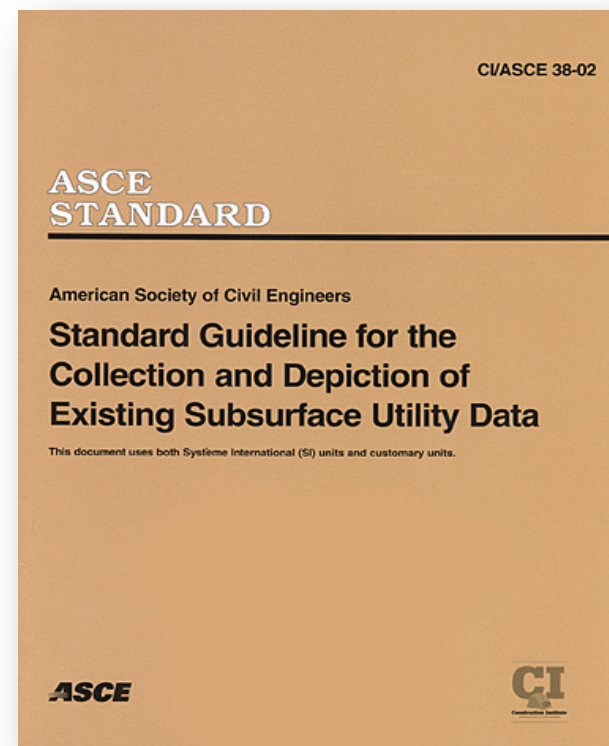
A branch of **ENGINEERING PRACTICE** that involves managing certain risks associated with:

- Utility Mapping at appropriate ASCE Quality Levels
- Utility Coordination
- Utility relocation and adjustment through conflict matrix resolution
- Utility relocation design and cost estimates
- Communication of utility data to concerned parties
- Implementation of Utility Accommodation Policies and utility design



CI/ASCE Standard 38-02

The American Society of Civil Engineers (ASCE) has developed a National Consensus Standard, CI/ASCE 38-02, titled “Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data”. This National Consensus Standard (NCS) is used by courts and lawyers, along with contractual instruments, to assist in both defining a professional’s standard of care and level of responsibility.





ASCE Standard – Quality Levels

QL-D information comes from existing utility records, permits, old plans, etc.

QL-C involves surveying visible above-ground utility facilities and correlating this information with QL-D information collected.

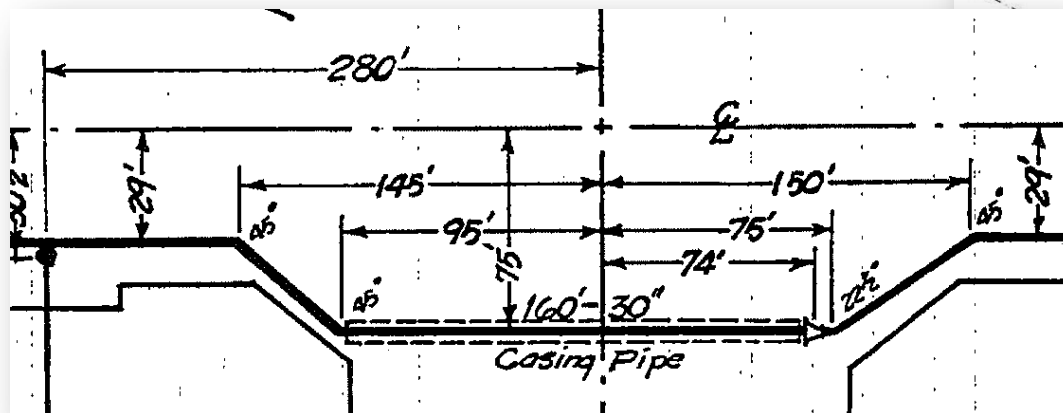
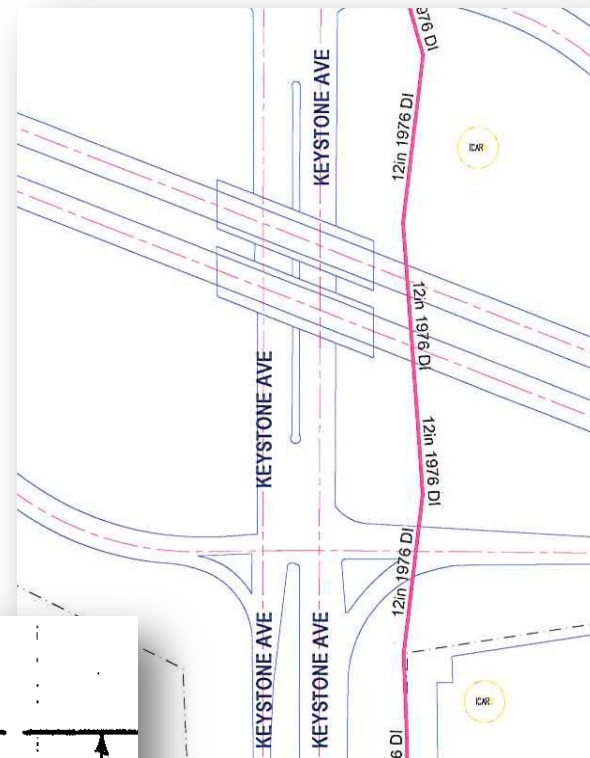
QL-B, or designating, involves the use of surface geophysical techniques to determine the existence and horizontal position of underground utilities.

QL-A, or locating, involves the use of non-destructive digging equipment at critical points to determine the precise horizontal and vertical position of underground utilities, as well as the type, size, material, and other characteristics of the utility.



ASCE Quality Level D (QL-D) *Existing Utility Records*

Involves the use of existing utility records, permits, plans to depict the 'approximate' horizontal position of underground utilities.





ASCE Quality Level C (QL-C) *Survey of Visible Features*

- Involves surveying visible above ground utility facilities to assist with determining 'approximate' horizontal position of underground utilities. Used with QL-D.
- Manholes
- Power poles
- Hydrants





ASCE Quality Level B (QL-B) *Determining Horizontal Alignment*

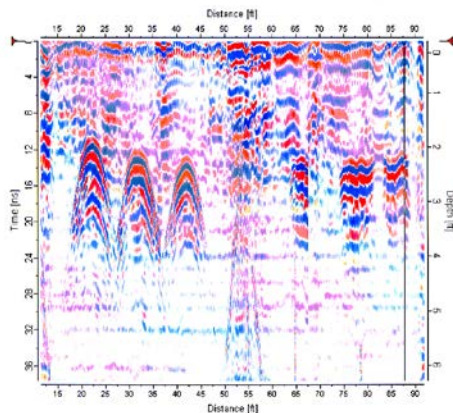
- Involves the use of geophysical prospecting equipment to determine the existence and horizontal position of underground utilities. Accuracy is +/- 2 inches
- Paint markings
- Flags





Designating Equipment

- Electromagnetic (metallic)
- Acoustical – Pulse (non-metallic with fluid)
- Sonic / Sonde (open access)
- Ground Penetrating Radar (GPR)
- Non-destructive probing





Designating Approach

Quality Assurance/Quality Control

- All data is checked and cross-checked for accuracy – Records research vs. designating file
- Field sketch
- Designating data point & numbering system

Utility	# of points	Comments/ Notes/ Location
W1	20	East side of road
W2	4	West side of road
W3	12	NB lane





ASCE Quality Level A (QL-A) *Utility Locating*

Involves the use of non-destructive digging equipment at critical points to determine the precise horizontal and vertical position of underground utilities, as well as the type, size, material, and other characteristics.





Subsurface Utility Engineering Approach

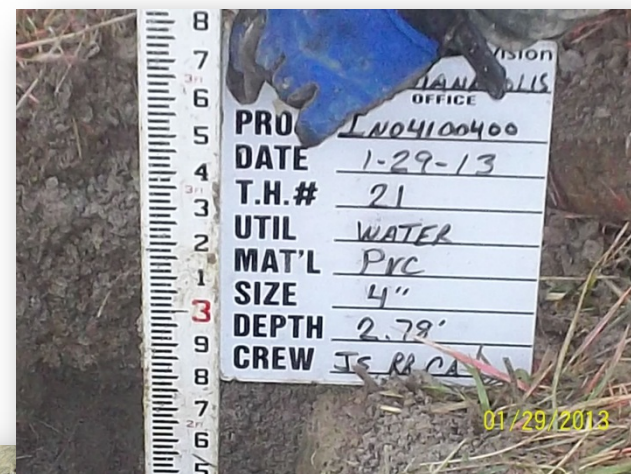
- Permitting
- Minimal disturbance
 - Saw cut in pavement
 - Air vacuum excavation
- Centerline of facility
 - Permanent reference points
- Proper restoration
 - Compaction in 6" lifts
 - Perma-Patch

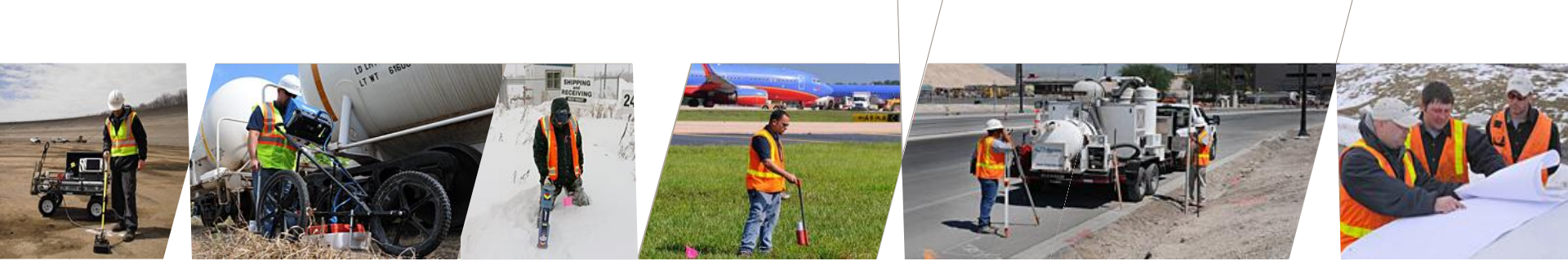




Project Control: *Quality Assurance/Quality Control*

- Test Hole Data Collection – 2 photographs of every test hole for permanent record
- Final QA/QC of all Subsurface Utility Engineering work is done by registered Professional Engineer





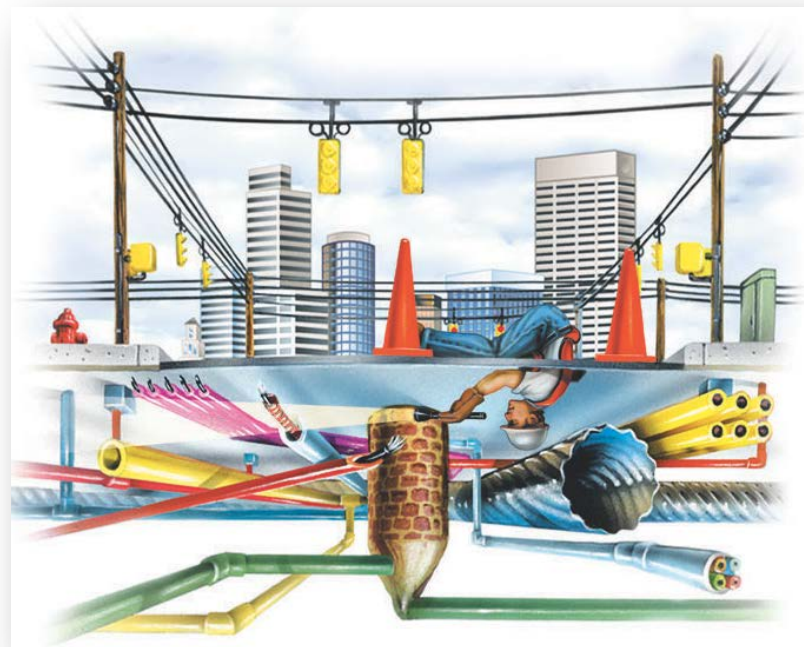
When to Use SUE?

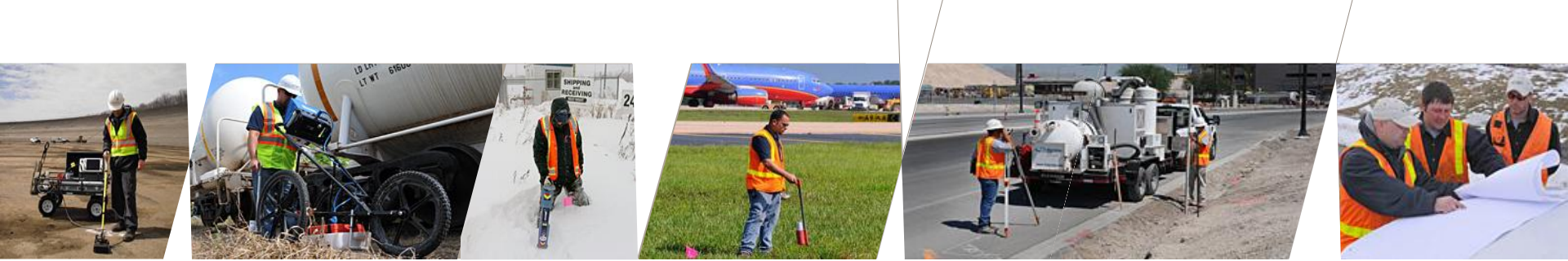




When to Use SUE?

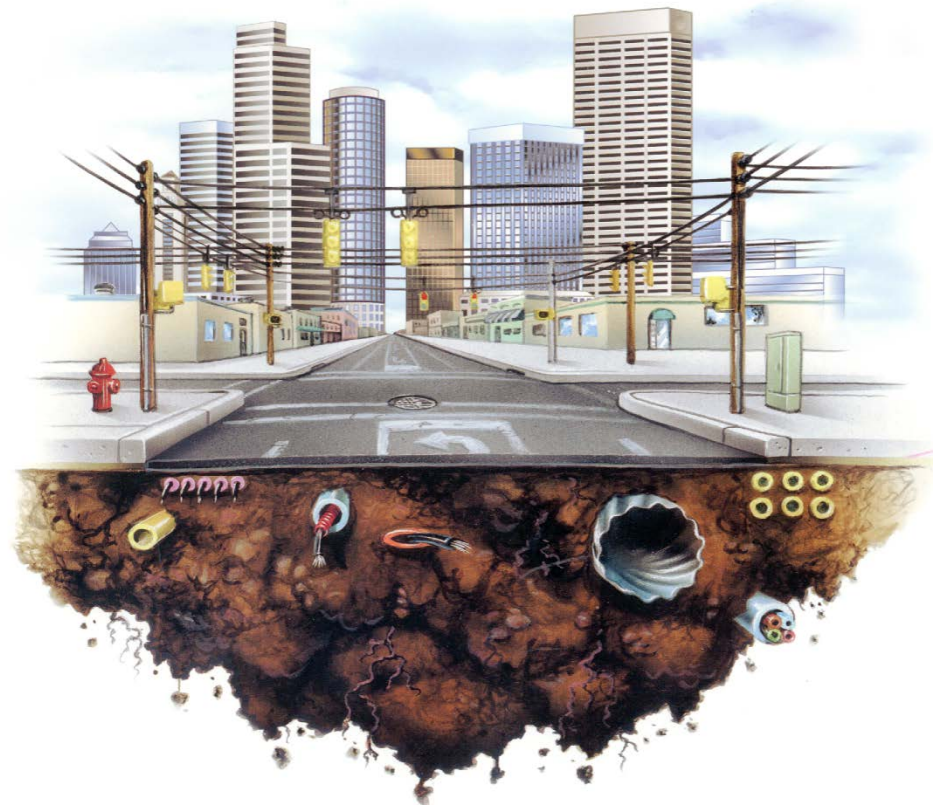
- Type of Project
 - Piping and Facility Design (storm, sanitary, water)
 - Site and Plant Design
 - Roadway / Bridge const.
 - Widening / Intersection Improvements
 - Signal Replacement
- Location of Project
 - Urban / Suburban
 - Rural





When to Use SUE?

- Utilities involved
 - Major or Minor
- Conflicts with utilities
- Compensable interest
- Limited Access R/W
- Accuracy required
 - ASCE Quality Level?
- Level of Risk





What are the Risks?

- Project delays
- Damage to utilities
- Safety of workers
- Safety of public
- Redesign costs
- Higher bids
- Change orders
- Extra work orders
- Construction claims
- Higher insurance costs
- Higher financing costs
- Detours
- Negative publicity



How Do We Use SUE?

- Commitment to avoid unnecessary utility relocations
- Communicate with Utilities early & often
- Records Research – QLD
- Utility Designating – QLB
- Topographic Survey – QLC
- Review of QLB, QLC & QLD
- Preliminary Design
- Utility Conflict Analysis
- Utility Locating – QLA
- Design Alternatives



Design Alternatives

- Geometric Alignment
 - > Change grade
 - > Shift alignment
 - > Widen on one side of the road
 - > Shift ramps or driveways



Design Alternatives

- Structure Design
 - > Alter footing / piling designs
 - > Provide alternative foundations
 - > Modify bridge layout
 - > Shift or modify retaining walls





Design Alternatives

- Drainage Design
 - > Dual trunk line in lieu of single trunk
 - > Shift ditches
 - > Shift structure locations (inlets, pipes, manholes)
 - > Open vs. closed system
 - > Modify side slopes or ditch slopes



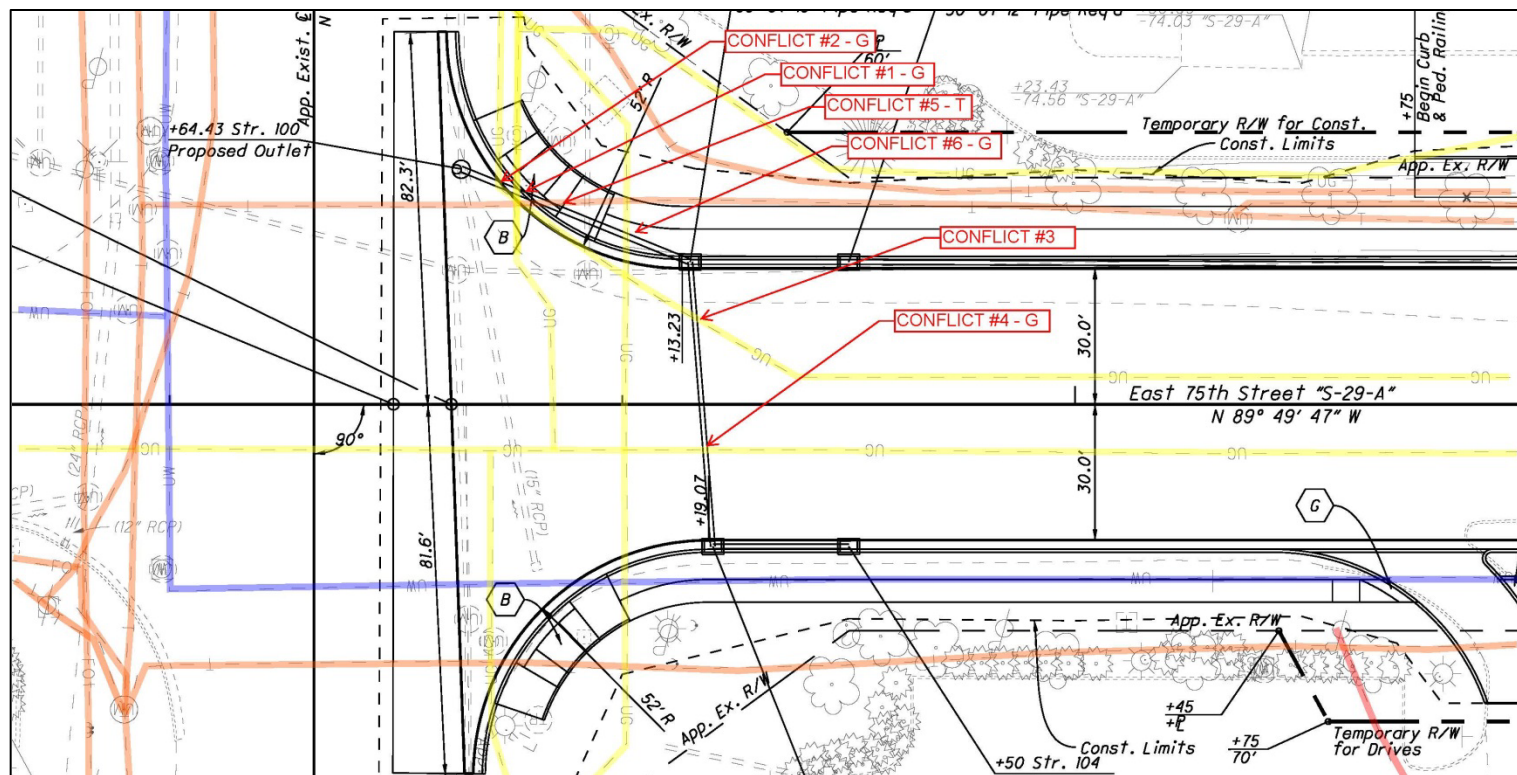
How Do We Use SUE?

- Utility Conflict Analysis / Matrix
 - ✓ Identify every utility conflict with the proposed design

Conflict Number	Station and Offset (BL)	Utility	Identified Conflict	Test Hole Needed	Test Hole No.	Utility Impact with Cost ("As-designed")	Recommended Resolution	*Benefit of Resolution



How Do We Use SUE?





How Do We Use SUE?

■ Utility Conflict Analysis / Matrix

Conflict Number	Station and Offset (BL)	Utility	Identified Conflict	Test Hole Needed	Test Hole No.	Utility Impact with Cost ("As-designed")	Recommended Resolution	*Benefit of Resolution
1	43+78 25' L	2" G	Storm pipe	Yes	#107	Adjust gas main \$5K	Adjust drain pipes	Avoid impact
2	43+75 27' L	16" G	Storm pipe	Yes	#108	Adjust gas main \$20K	Adjust drain pipes	Avoid major impact
3	44+24 10' L	16" G	Storm pipe	Yes	#109	Adjust gas main \$20K	Adjust drain pipes	Avoid major impact
4	44+25 8' R	20" G	Storm pipe	Yes	#142	Adjust gas main \$20K	Remove pipe	Avoid major impact

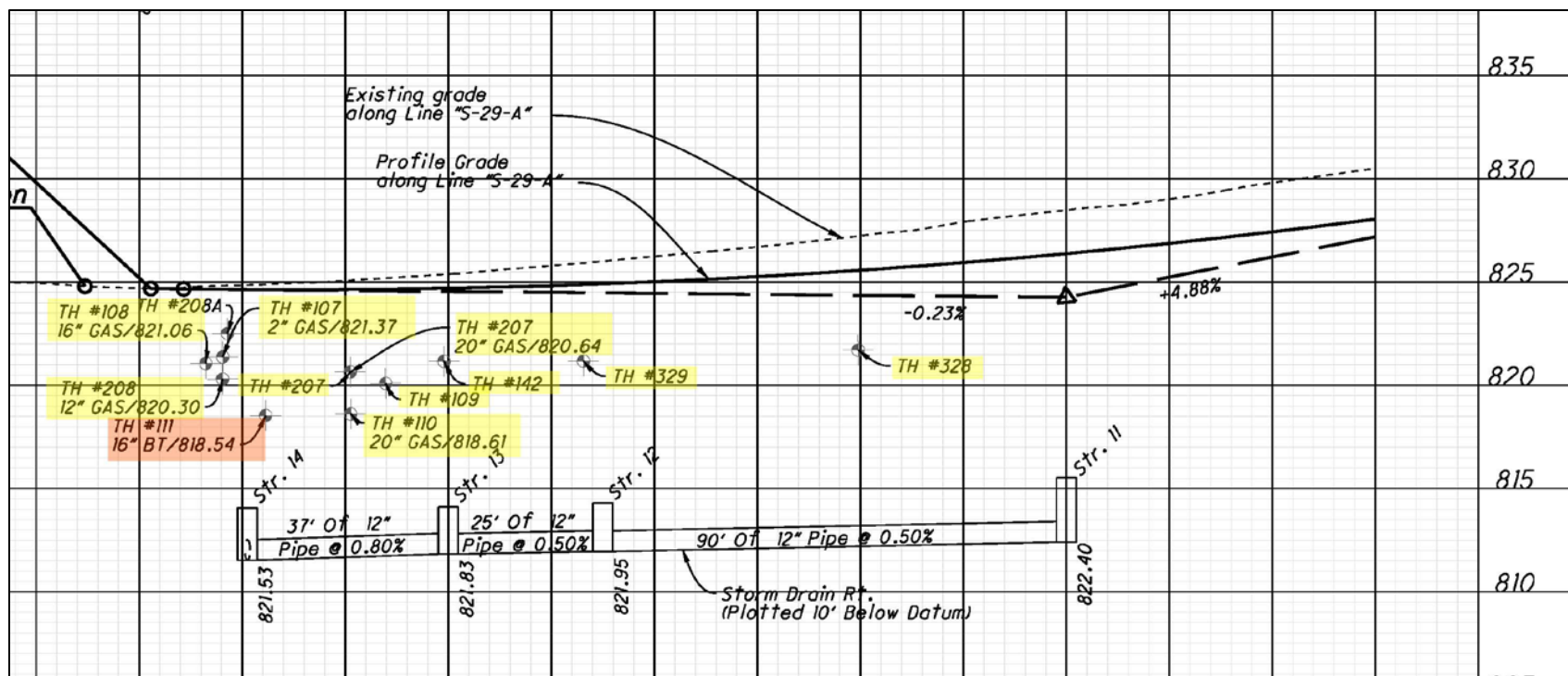


How Do We Use SUE?

Verified Utility Information							
Test Hole #	Size & Type	Northing	Easting	Existing Top Elevation	Existing Cut	Reference Elevation	Comments
107	2" G	3732.607	73215.659	821.37'	2.65'	824.02'	UTILITY QUALITY LEVEL "A"
108	16" G	3729.535	73218.954	821.06'	2.88'	823.94'	UTILITY QUALITY LEVEL "A"
109	16" G	3752.438	73184.085	820.90'	3.46'	824.36'	UTILITY QUALITY LEVEL "A"
110	20" G	3742.405	73190.845	818.61'	5.27'	823.88'	UTILITY QUALITY LEVEL "A"
111	16" BT	3733.836	73207.357	818.54'	5.44'	823.98'	UTILITY QUALITY LEVEL "A"
112	16" W	3842.021	71695.928	817.32'	4.85'	822.17'	UTILITY QUALITY LEVEL "A"
113	0.75" BT	3847.089	71694.958	819.13'	3.11'	822.24'	UTILITY QUALITY LEVEL "A"
114	10" W	3523.934	72002.368	817.94'	5.38'	823.32'	UTILITY QUALITY LEVEL "A"
115	16" W	3806.647	71426.343	820.00'	4.24'	824.24'	UTILITY QUALITY LEVEL "A"
116	0.75" TV	3808.399	72896.679	829.19'	3.52'	832.71'	UTILITY QUALITY LEVEL "A"
117	SEE NOTE G	3819.971	72836.592	820.00'	10.61'	830.61'	UTILITY QUALITY LEVEL "B"
118	SEE NOTE G	3803.192	72893.997	822.21'	11.46'	833.67'	UTILITY QUALITY LEVEL "B"
119	16" W	3820.258	72934.521	824.24'	6.34'	830.58'	UTILITY QUALITY LEVEL "A"

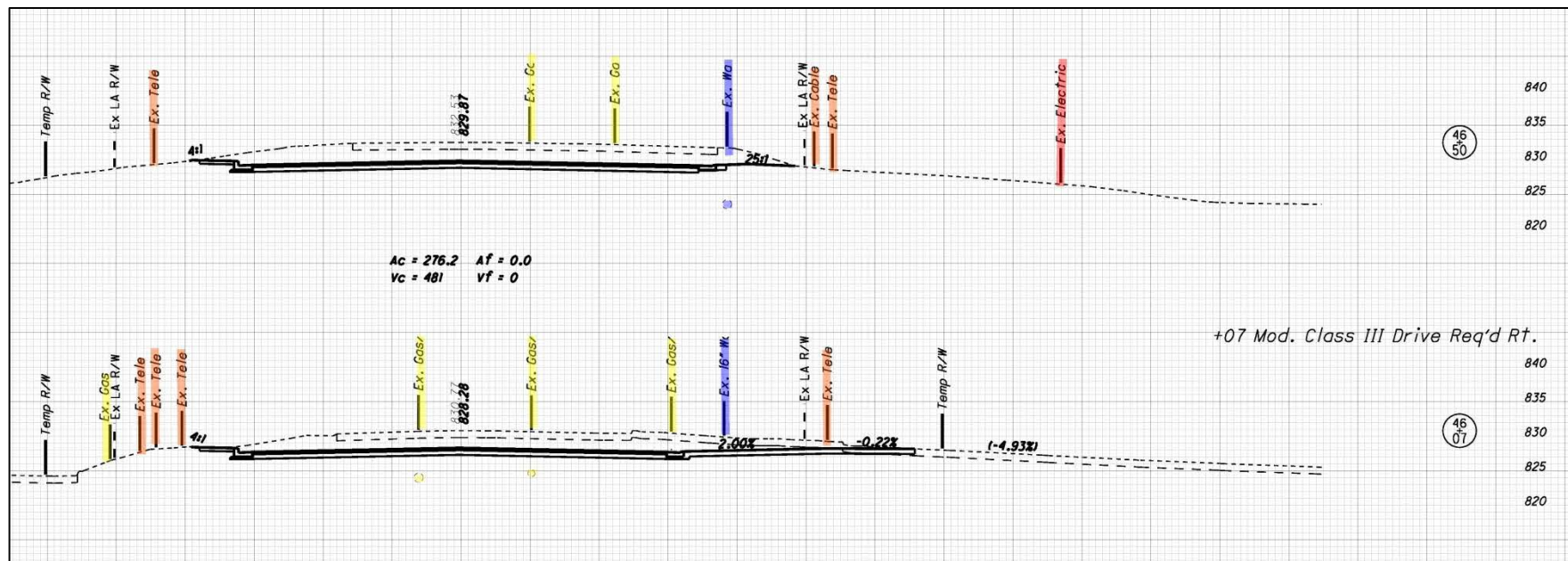


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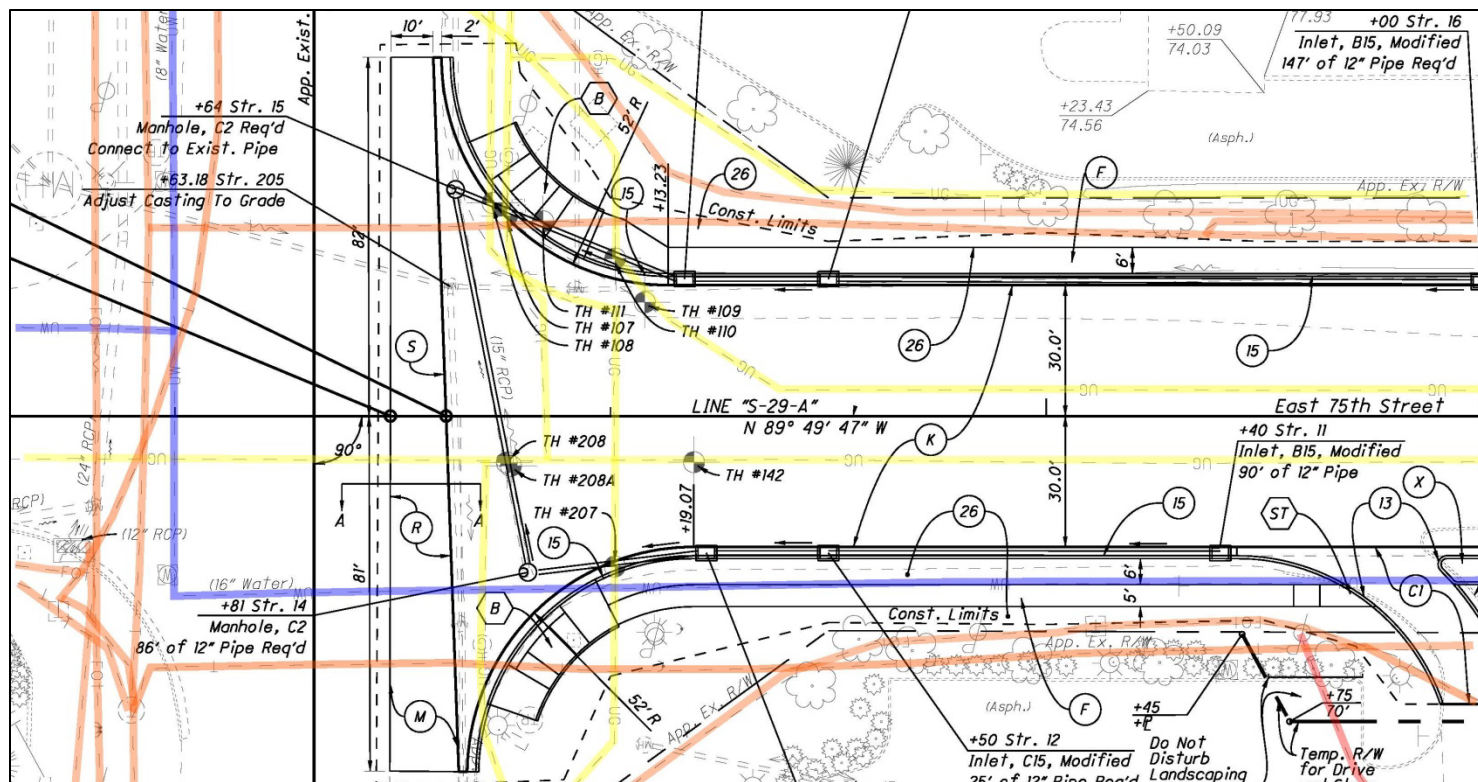


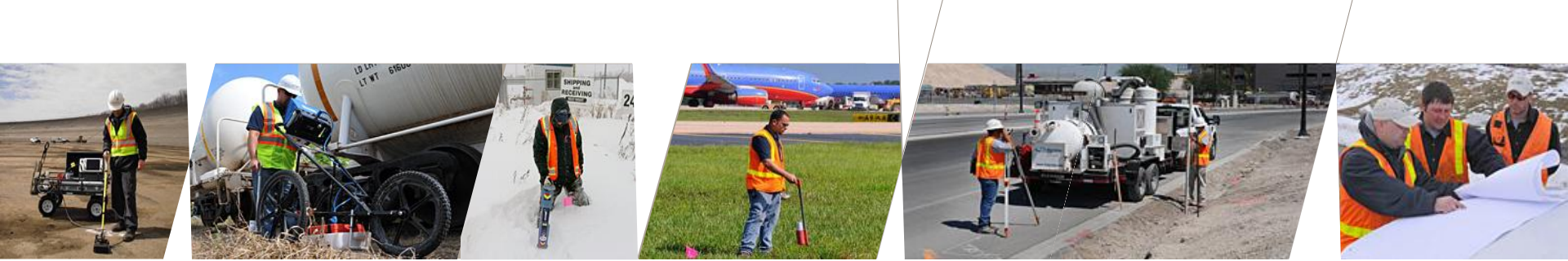
How Do We Use SUE?





How Do We Use SUE?





Why Use Subsurface Utility Engineering?





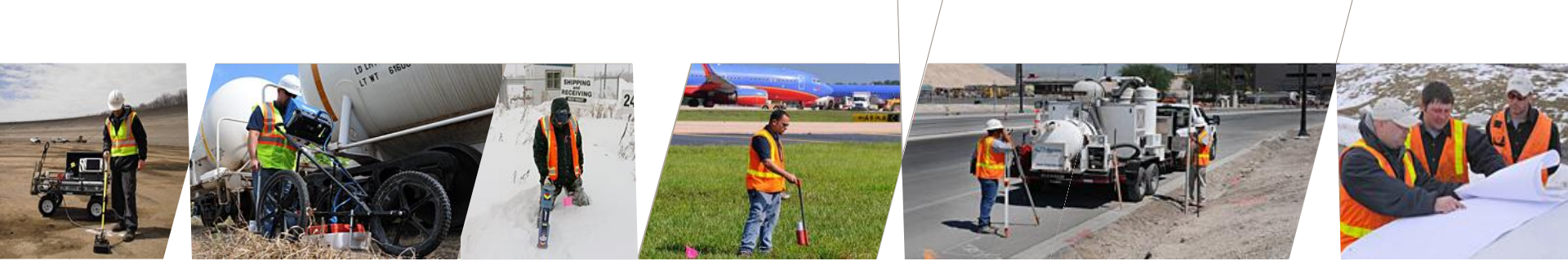
Why Use Subsurface Utility Engineering?





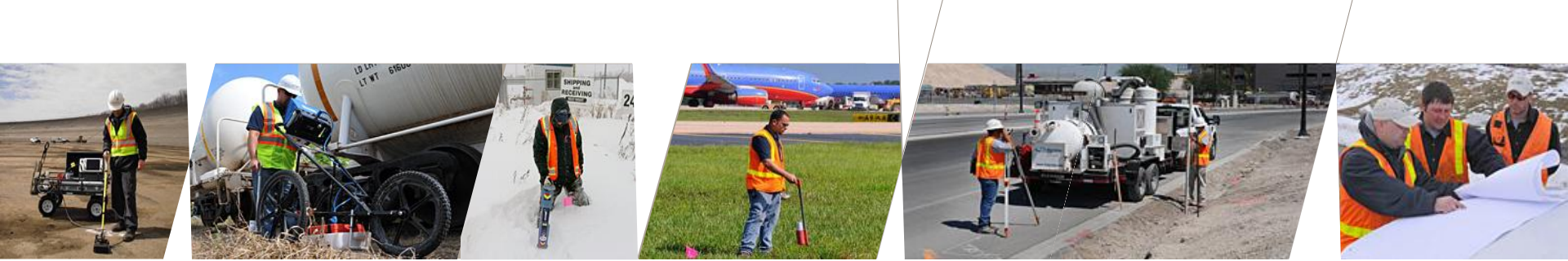
Why Use Subsurface Utility Engineering?





Why Use SUE?

- **Make Informed Design Decisions**
 - Designers require accurate utility information, including constructability of multi-phase projects.
- **Avoid Using Unreliable Underground Utility Information**
 - Avoid uncertainty and second guessing where a utility may be located.



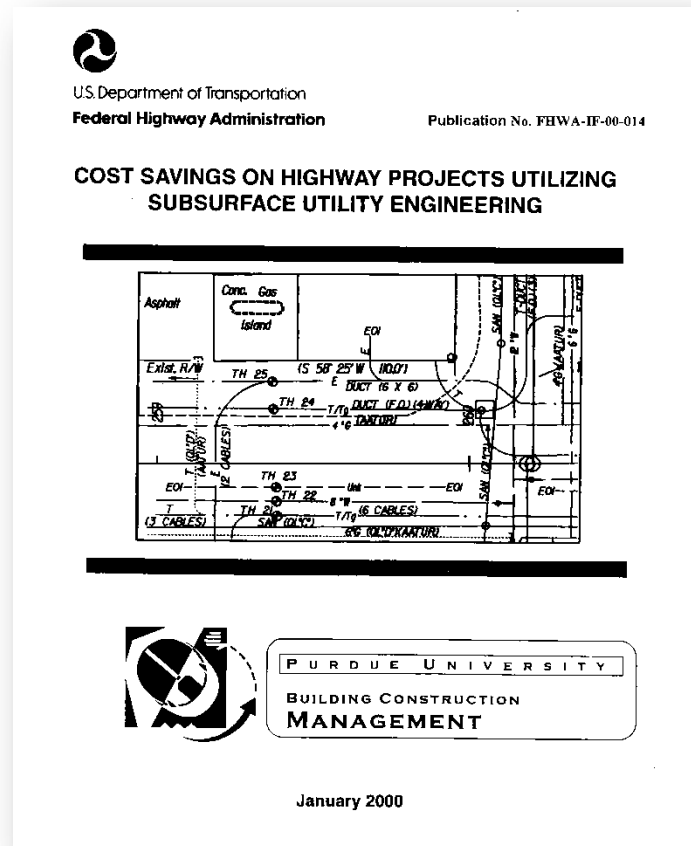
Why Use SUE?

- **Avoid Costly Conflicts / Utility Relocations**
 - By knowing the exact horizontal and vertical locations of underground utilities, costly conflicts and utility relocations may be avoided, along with not having to depend upon the utilities to relocate before construction can occur.
- **Savings and Safety**
 - Inaccurate information can result in costly conflicts, utility damage, construction delays, service disruptions, redesign, claims, and even injuries and loss of life.



Relative Cost Savings & Benefits

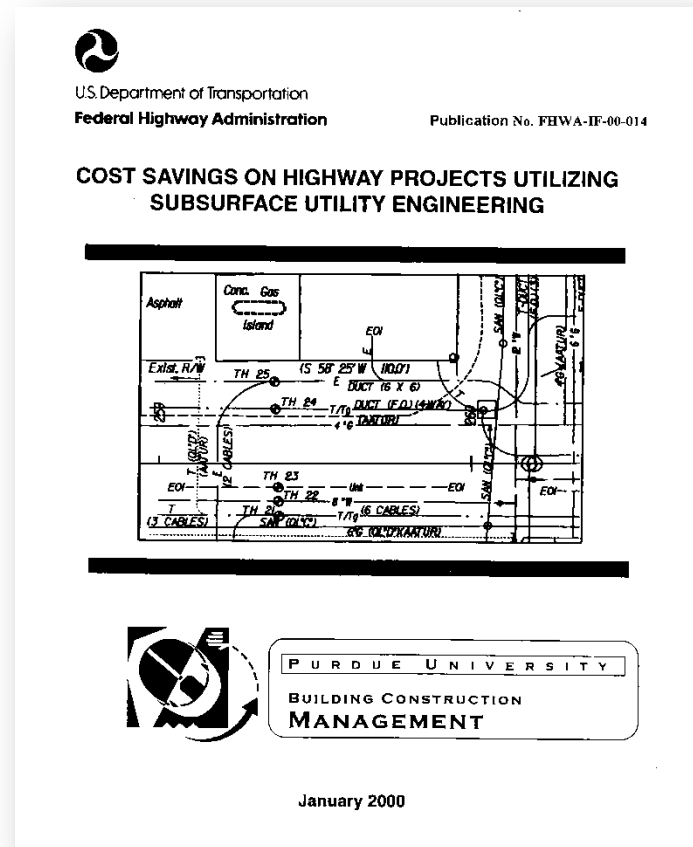
- Purdue Study
 - Commissioned by FHWA
 - 71 projects studied in 4 states (VA, NC, OH, TX)
 - Projects valued at >\$1B
 - SUE was < 0.5% of construction costs
 - Both QLB & QLA performed





Relative Cost Savings & Benefits

- **Purdue Study**
 - Cost savings of \$4.62 per \$1.00 spent on Subsurface Utility Engineering
 - Largest return on investment was \$208/\$1
 - 1.9% savings on construction costs
 - Quantitative costs only (Qualitative costs not included)
 - SUE is a viable practice that reduces project costs related to the risks associated with underground utilities
 - If used properly it could result in a minimum savings of \$1 billion per year





Relative Cost Savings & Benefits

- University of Toronto Study
 - Ontario based study commissioned by OSWCA
 - September 2004 to October 2005
 - Cost Savings of \$3.41 per \$1.00 spent on Subsurface Utility Engineering





SUE Current Practice

Owner and Engineer Responsibility

In an increasing number of states, lawyers and courts are using guidelines, agency policies, and contractual instruments to define and hold professionals accountable for their standards of care.

It is an Engineer's responsibility, on behalf of an Owner, to utilize all available resources and methods to gather and provide the most accurate information possible.



Additional Information



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Question and Answer Session